Operating Experience Weekly Summary 97-33

August 8 through August 14, 1997

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EVENTS

1. TYPE B INVESTIGATION OF PLUTONIUM INTAKE AT SAVANNAH RIVER

In July, 1997, the manager for the DOE Savannah River Operations Office released the findings for the Type B accident investigation of the plutonium intake by a crane operator at the Savannah River Site F-Canyon. The following is a summary of this report. (ORPS Report SR--WSRC-FCAN-1997-0009 and Type B Accident Investigation Board Report of the Plutonium Intake by a Crane Operator at the Savannah River Site F-Canyon)

On February 10, 1997, an F-Canyon crane operator submitted a routine, semi-annual bioassay sample that was positive for plutonium. His prior routine sample submitted on August 4, 1996, was negative, indicating he was internally contaminated between August 4, 1996, and February 10, 1997. Follow-up bioassay samples indicated the crane operator may have received an estimated occupational exposure of 17 rem, 50-year Committed Effective Dose Equivalent (CEDE), based on an assumed mid-point intake date of November 7, 1996. The 17-rem CEDE results in an actual first year dose of approximately 750 mrem. Analysis of the bioassay samples indicated inhalation was the mechanism for the intake based on the rate and pathways of elimination from the body. The samples also reflected significant alpha radioactivity, while the amount of beta and gamma radioactivity was below minimum detection levels. A Type B Accident Investigation Board could not determine a direct causal event for the crane operator's intake. However, they were able to conclude the intake resulted from a lack of discipline in fully implementing radiological controls and requirements for peripheral work in radiological areas.

On May 1, 1997, the manager for the DOE Savannah River Operations Office established the Type B Accident Investigation Board because the estimated 50-year CEDE met the criteria for a Type B Accident Investigation in accordance with DOE Order 225.1, *Accident Investigation*, Attachment 2. The Board members could only account for approximately 30 percent of the crane operator's activities during the period under investigation because of the operator's lack of memory recall and the lack of records and lack of sufficient details in available records. As a result, they could not determine the direct causal event. However, Board members concluded sufficient data existed for known activities to enable analysis of four probable scenarios. The commonality of causal factors for each of the four analyzed scenarios enabled them to determine the direct, root, and contributing causes.

The Board members screened the crane operator's work activities to determine which activities presented a high potential for his intake. They used specific work activities consistent with bioassay results (alpha-emitting contamination) and unusual radiological conditions or lack of radiological control operations coverage as the criteria for the screening. The Board members identified the following four activities to be high-potential scenarios for the intake.

- Warm Canyon Cell Cover Activity—Unauthorized work on canyon cell covers may have resulted in contamination of the crane operator's protective clothing and subsequent internal contamination while in the cab of the Old Warm Crane. The maximum transferable contamination found on the cell covers was 300,000 dpm/100 cm^2.

- Old Warm Crane Operation—The crane operator may have been exposed to high airborne levels of radioactivity in the crane cab as a result of an event in the canyon. Personnel protection equipment (air monitors, air samplers, and ventilation systems) on the crane cab had numerous operational problems, and the operator may have had no respiratory protection.

- Warm Gang Valve Corridor Decontamination—The crane operator may have performed decontamination work in an airborne radioactivity area without proper respiratory protection. The crane operator did not sign out a respirator as required by the radiological work permit. The crane operator worked in an area with alpha contamination levels as high as 200,000 dpm/100 cm^2 for 3 hours without radiological control inspector coverage.

- Warm Gang Valve Corridor Hut Removal—The crane operator may have been exposed to an airborne radioactivity release without respiratory protection during removal of the hut. High airborne levels occurred, and Board members believe the crane operator was in the area.

The Board reviewed the applicable radiological work permits and respiratory protection sign-out sheets. They determined that the crane operator signed onto 21 radiological work permits requiring respiratory protection, but signed out respiratory protection only 13 times.

The Board's findings were associated with selected peripheral work activities in radiological areas in F-Canyon. This work supported, but was not directly related to, separations chemical processing. The work included area decontamination, jumper-gasket replacement, installation and removal of radiological huts, waste handling, and general housekeeping. These activities were routinely performed without supervision, were not perceived to require a high technical skill level, and did not normally receive management attention.

The Board members determined the direct cause for the crane operator's intake was his failure to wear respiratory protection in an airborne radioactivity area. They determined the root cause of the intake was a lack of discipline in fully implementing radiological controls and requirements for peripheral work in radiological areas. Board members determined the contributing causes for the intake were (1) lack of operations supervision and management oversight for peripheral work, (2) lack of radiological controls supervision and management oversight for peripheral work, and (3) inadequate management analysis of operational and radiological conditions associated with peripheral work.

The Board concluded that Westinghouse Savannah River Corporation failed to adequately implement radiological controls and requirements for peripheral work. They also failed to provide (1) an adequate level of operations supervision and management oversight for peripheral work, (2) an adequate level of radiological controls supervision and management oversight for peripheral work, and (3) adequate management analyses of operational and radiological conditions associated with peripheral work activities. The Board identified the following judgments of need to prevent recurrence of this type of incident.

- Improve implementation and enforcement of radiological conduct of operations, including posting and control of radiological areas per the radiological control manual.

- Develop and implement a program to analyze all facility activities for proper engineered radiological controls with reliance on engineered containments and ventilation systems.

- Improve enforcement of conduct of operations, including procedural compliance and improved operating procedures.

- Designate a "person in charge" for all work activities.

- Analyze operations of the Old Warm Crane and improve the reliable operability of associated protective equipment if the crane is to be used.

- Evaluate all accessible canyon areas for potential reduction of contamination/radiation levels.

- Increase involvement, surveillance, and performance-based assessment of peripheral work by radiological supervision and management.

- Improve implementation of the Integrated Safety Management System by including peripheral work.

- Improve management and supervisory review and analysis of operational and radiological conditions for peripheral work (including procedures, logs, records, checklists, and radiological surveys).

During the course of the investigation, the Board found numerous examples of individuals failing to adhere to established requirements for peripheral work in radiological areas. The Board concluded that this was because peripheral work involved activities usually performed without supervision and not perceived to require a high technical skill level. Workers followed generic procedures that provided little guidance or direction because the nature of the work was perceived as not requiring direction or as depending on "skill of the craft." Peripheral work received little or no management attention because of its routine nature. Because of the generally routine nature and the perceived simplicity of the work, lack of discipline can lead to bypassing requirements that individuals believe do not necessarily contribute to safety.

Facility managers should ensure that peripheral work activities, such as emptying waste containers, decontaminating areas, building and disassembling radiological huts, and performing general housekeeping, are conducted in accordance with adequate radiological work practices, are properly supervised, and are supported by radiological control personnel.

KEYWORDS: internal exposure, inhalation, plutonium, respirator, radiation protection

FUNCTIONAL AREAS: Radiation Protection, Operations

2. TECHNICIAN RECEIVES ELECTRICAL SHOCK DURING SOURCE TESTING

On August 4, 1997, at the Oak Ridge National Laboratory Metals and Ceramics Facility, an instrument technician received an electrical shock while source-testing a radiation monitoring instrument because the ground conductor for an alarm bell was on the wrong connector pin. The technician's arm made contact with a wall-mounted metal shelf that had the alarm bell chassis bolted to it. The radiation monitoring instrument was also on the shelf. When the instrument's high-level alarm actuated, it energized the alarm bell chassis and the shelf with 115 volts ac. Maintenance personnel had installed the alarm bell to test the audible response of radiation monitoring instruments. Investigators determined that the alarm bell had been mis-wired. The incorrect wiring exposed employees to an electrical shock hazard. (ORPS Report ORO--ORNL-X10METCER-1997-0008)

Instrument maintenance personnel measured voltages at various locations on the instrument to determine the cause of the shock. The alarm bell chassis, which is bolted to the wall-mounted shelf, measured 115 volts ac when the instrument alarmed. Maintenance personnel replaced the alarm bell, re-tested it, and found no indication of voltage on the chassis. When they inspected the old bell, they saw that the ground conductor was on the wrong connector pin.

Maintenance personnel are inspecting similar instruments throughout the facility and Radiation Protection has been alerted to the problem. Facility management notified managers of all facilities about the potential hazard.

NFS reported events where facility-manufactured or modified equipment exposed personnel to shock hazards in Weekly Summaries 96-42, 96-39, 96-30, 96-18, and 95-16.

- Weekly Summary 96-42 reported that on September 30, 1996, at Fernald, an electrical arc occurred when an electrician placed an inoperable set of electro-hydraulic shears on a metal floor. After the event, another electrician removed the extension cord and found that a lead wire and the ground wire had been switched in the male connector. Investigators determined that the mis-wiring caused the power pack casing to be energized. (ORPS Report OH-FN-FDF-FEMP-1996-0054)

- Weekly Summary 96-18 reported that on April 30, 1996, at the Savannah River Site, an electrical and instrumentation mechanic received an electrical shock because someone made an unauthorized change to the configuration of a plug. The mechanic was using a 480-volt, motor-operated valve test box to confirm operability of a valve motor when he was shocked. The mechanic was exposed to electrical shock hazards because a plug was incorrectly wired and no one was aware of the modification. (Lessons Learned Document 1996-SR-WSRC-1996-0005, and ORPS Report SR--WSRC-WVIT-1996-0012)

- Weekly Summary 95-16 reported an electrical shock hazard at the Hanford Tank Farms, where the chassis of a truck was accidentally connected to a 120-volt ac source through a mis-wired transformer connection. Electricians discovered that the transformer ground cable was connected to a 120-volt supply, causing the truck chassis to be energized instead of grounded. (ORPS Report RL--WHC-TANKFARM-1995-0039)

Corrective actions for these events included (1) maintaining test boxes under strict control, (2) updating training programs, (3) requiring post-fabrication inspections of equipment, (4) requiring equipment to be functionally tested before use, and (4) ensuring that test equipment is physically and administratively controlled.

These events are significant because facility personnel were exposed to electrical shock hazards from incorrect wiring. Training personnel at DOE facilities should consider enhanced training in electrical safety for personnel working on electrical equipment. In addition, facility managers should ensure that facility-manufactured or modified equipment is evaluated for personnel safety before use. DOE/ID-10600, *Electrical Safety Guidelines,* section 8.0, "Temporary Wiring," provides guidance on installing, using, and testing temporary wiring. The introduction to section 8.0 states that, in general, temporary wiring must comply with all requirements pertaining to permanent wiring. Specific exceptions to these requirements are given in NFPA 70 - *National Electric Code* 1996 Edition, article 305, “Temporary Wiring.” Exceptions are also given under the OSHA regulations in 29 CFR 1926, sub-part K, *Electrical* (construction), and 29 CFR 1910, sub-part S, *Electrical*. National Fire Protection Association Standard 70B, *Recommended Practice for Electrical System Maintenance*, also provides guidance on maintenance for temporary wiring.

KEYWORDS: electrical shock, electrical, maintenance, modification

FUNCTIONAL AREAS: Industrial Safety, Hazards Analysis, Electrical Maintenance

3. TRUCK STRIKES UTILITY POLE GUY WIRE CAUSING POWER OUTAGE

On August 5, 1997, at the Hanford Site, a truck snagged a power pole guy wire, pulling the pole to the ground and severing the 13.8-kV electrical lines. The power lines landed 7 feet from the truck, with the broken guy wire draped over the truck. A 13.8-kV circuit breaker tripped and locked out on protective relay, causing a power outage to a large portion of the 200 West Area. Line crews responded and physically isolated the damaged section of the power line. The driver of the truck remained in the vehicle until line crews determined it was safe to exit. Paramedics assessed the driver's medical condition and determined he was not injured. Investigators determined that driver error was the cause of the incident. Failure of the driver to recognize a hazard in the work area resulted in damage to the guy wire and the power outage. (ORPS Report RL--PHMC-GENERAL-1997-0008)

Investigators determined that the driver of the truck initially drove off a street and between the power pole and guy wire to position his truck near a portable toilet that required servicing. The clearance from the pole to the guy-wire anchor was 31 feet, and the guy wire was marked with yellow tape. When the driver was leaving, he backed the truck between the guy wire and pole, then pulled forward. Investigators also determined that a wing nut for a lid on the truck-mounted tank snagged the guy wire. The driver stated that he drove between the pole and guy wire to get a greater turning radius. When he opened the door to see what had happened, witnesses to the incident cautioned the driver to remain in the truck because of the potential for electrocution. Line crews physically isolated the section of line on the ground and repaired the damaged poles, aerial lines, and power-line section.

OEAF engineers reviewed another event this week involving the downing of a power line. On August 7, 1997, at the Argonne National Laboratory—East, a front-end-loading garbage truck snagged an overhead 110-volt power line with a large recycle container. The container was on the forks of the truck, with the forks in the raised position to provide visibility. The container severed the line approximately 15 feet from a pole. The driver exited the truck, moved the downed line to the side of the road, and drove to a fire station to report the incident. The driver was not injured. The power line provided power to street lights, but they were not energized. (ORPS Report CH-AA-ANLE-ANLEPFS-1997-0005)

Fire Department personnel responded to the scene and secured the area. A line crew verified that the downed power line was de-energized and restored the line. Facility personnel will conduct a comprehensive survey of the site to assure that all areas where traffic passes under overhead power lines are in conformance with the National Electrical Safety Code, section 23, "Clearances."

NFS reported similar events in Weekly Summaries 97-02, 96-49, 96-46, and 92-31. These events all involved the failure to use spotters and lack of operator awareness of overhead lines and obstructions.

- Weekly Summary 97-02 reported that on December 31, 1996, an operator at the Savannah River Site inadvertently backed a front-end loader into a guy wire causing it to break. The cut guy wire contacted and short-circuited a 13.8-kV transformer resulting in a power outage. Investigators determined that a work package did not address safe working distances from wires as specified in a safety manual. (ORPS Report SR--WSRC-SLDHZD-1996-0029)

- Weekly Summary 96-49 reported two events where dump trucks contacted overhead lines with raised truck boxes, and no spotters were used. On November 26, 1996, at Hanford, a dump truck contacted a local area network cable. (ORPS Report RL--PHMC-TANKFARM-1996-0016) On November 22, 1996, at Argonne National Laboratory—East, a dump truck snagged an overhead 120/240-volt power line and

communication lines. Investigators determined that no one performed a review for overhead line hazards. (ORPS Report CH-AA-ANLE-ANLEPFS-1996-0009)

- Weekly Summary 96-46 reported that on November 6, 1996, an operator at the Idaho National Engineering Laboratory backed a forklift into a 480-volt and 208-volt overhead power bundle with the raised forklift mast. The operator failed to use a spotter and failed to inspect the overhead area around the work location. Corrective actions included installing concrete barriers to prevent vehicle access near the lines and requiring supervisors to walk down areas to identify potential hazards. (ORPS Report ID--LITC-PBF-1996-0001)

- Weekly Summary 92-31 reported that on November 17, 1992, workers at Oak Ridge Y-12 Site backed an equipment trailer into a power pole guy wire causing a short circuit and tripping a high-voltage circuit breaker. The driver and a passenger did not adhere to training they had received a month earlier on proper techniques for backing trailers. A corrective action was to equip site guy wires with guy guards for improved visibility. (ORPS Report ORO--MMES-Y12SITE-1992-0008)

OEAF engineers reviewed the Occurrence Reporting and Processing System (ORPS) database for events involving contact with guy wires and found 11 applicable reports DOE-wide. Figure 3-1 shows the distribution of root causes reported by facility managers for these events. Personnel error represented 60 percent of the root causes and management problems, 20 percent. Inattention to detail accounted for 60 percent of the personnel errors, and work organization/planning deficiency and inadequate supervision each accounted for 50 percent of the management problems. Because personnel problems, such as inattention to detail, accounted for the majority of the root causes, these events could have been prevented.

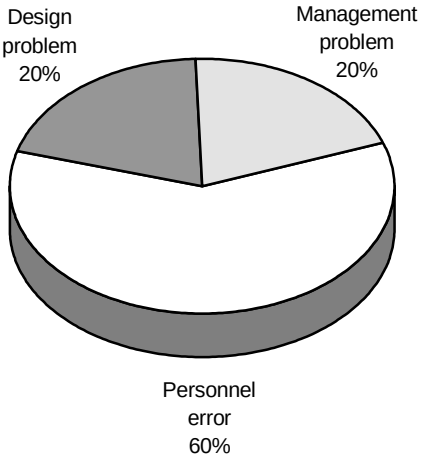

Figure 3-1. Distribution of Root Causes for Contacting Guy Wires[1]

[1]OEAF engineers reviewed the ORPS database for reports using the narrative search “guy wire” and found 17 reports from 1990 to present. A 100 percent review of these reports found 11 reports that were applicable.

These events demonstrate the importance of exercising extreme caution when front-end loaders, forklifts, cranes, and other vehicles are in the vicinity of guy wires, power lines, and switchyards. Pre-job briefings, facility procedures, and training programs should emphasize the dangers associated with these types of operations. Some events have occurred while personnel were backing up motive units, indicating that operators of equipment must be aware of hazards in all directions, including above them. Equipment operators should walk down areas to identify and evaluate overhead hazards. Spotters should be used if equipment will be operated in the vicinity of any overhead hazards. In the event of downed lines, personnel should always consider them energized until proven otherwise. Even if there is no current flow, an electrical potential could exist. Personnel should remain inside vehicles that are in contact with downed lines until authorities have verified that an electrical hazard does not exist.

DOE 4330.4B, *Maintenance Management Program*, section 8.3.1, provides guidelines on work control systems and procedures. The Order requires control procedures to help personnel understand the requirements for working safely. OSHA regulation 29 CFR 1926.550(a)(15)(iv), “Cranes and Derricks,” states that a person shall be designated to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means.

Section 1926.600(a)(6), “Equipment,” states: “all equipment covered by this subpart shall comply with the requirements of 1926.550(a)(15) when working or being moved in the vicinity of power lines or energized transmitters.” Section 1926.550(a)(15) requires a minimum clearance of 10 feet between any part of the crane or load and lines rated 50 kV or below, even if spotters are used. DOE facility managers should ensure that facility personnel and off-site vendors who operate equipment on site property are aware of any overhead hazards and that these hazards are clearly marked for clearance requirements and visibility.

KEYWORDS: pole, overhead, power line, power outage

FUNCTIONAL AREAS: Industrial Safety, Work Planning

4. UNDERGROUND ELECTRICAL AND TELEPHONE LINES SEVERED

This week OEAF engineers reviewed four events where workers severed underground electrical and telephone lines. All of the events occurred on August 7 and 8, 1997. At Hanford, a subcontractor performing renovation activities in a building basement cut a conduit containing an energized 110-volt line. At Lawrence Livermore National Laboratory, a contractor cut an underground energized 480-volt line while using construction equipment to loosen the soil surface. At the Hanford Waste Encapsulation and Storage Facility, a back-hoe operator performing excavation activities severed an abandoned underground telephone line. When work resumed on the next day, the back-hoe operator severed an abandoned, de-energized electrical cable. Failure to identify buried conduit or power lines before construction activities can cause personnel injury, damage equipment, and adversely affect facility operation. (ORPS Reports RL--PHMC-WESF-1997-0007, RL--PNNL-PNNLBOPER-1997-0023, and SAN--LLNL-LLNL-1997-0051)

- During laboratory renovation activities, a Hanford concrete-cutting subcontractor cut through a conduit containing an energized 110-volt line while saw-cutting a basement floor slab. He was not aware that he severed the line. Before starting the job another subcontractor, with expertise in scanning for and locating buried conduits, had scanned the basement floor. He indicated that most of the floor area was clear of buried conduits. He also advised that, because of measurement uncertainties, the area next to a wall was suspect. He recommended to the principle contractor that the cutting subcontractor make only partial cuts and hand-excavate the floor slab in the wall area. The principle contractor failed to provide this information to the cutting subcontractor. The job planning package included the scanning and concrete-cutting activities, but did not specify how to perform the work or identify a communication process for relaying information between all of the parties involved. No injuries or property damage resulted from this event. Investigators identified communication breakdowns in the work planning and control processes involving subcontractors and other third-party organizations as factors contributing to this event. They are continuing to investigate this event and others that occurred in the past few months involving subcontractor and third-party organization communication breakdowns. They will develop corrective actions when the investigation is completed.

- At Lawrence Livermore National Laboratory, a contractor using a piece of construction equipment to break up and loosen the soil surface snagged and broke an energized underground 480-volt electrical line. The contractor’s survey personnel performed line-location surveys and reviewed the applicable drawings before the contractor started the job. The 30-year-old drawings indicated the 480-volt line was 3 feet underground, and survey personnel confirmed the location of

the line at several locations with a detector. However, the 480-volt line was less than 6 inches below the surface in the area where the contractor broke the line. The line supplied power to a diagnostics area for a linear accelerator in an explosives testing facility. Facility managers decided not to use a lockout/tagout on the line for this work so they could continue to collect data from the accelerator. De-energizing and locking out the line would not have prevented the contractor from snagging and breaking the line; however, it would have provided a positive barrier for personnel safety. There were no injuries or equipment damage. Facility managers stopped all work in the area. An investigative analysis team is reviewing this event. Corrective actions will be implemented when the investigation is completed.

- At the Hanford Waste Encapsulation and Storage Facility, construction personnel severed an abandoned telephone line and an abandoned electrical cable while excavating an area to cap unused utility lines. Permit personnel issued an excavation permit for this work after completing reviews and a partial line-location scan. The scan showed an abandoned telephone line, but not in the area to be excavated. On August 7, a back-hoe operator severed the telephone line. Facility personnel held a critique and determined that drawings and the results of the partial scan indicated that the line ran straight. However, it actually curved underground. Excavation of a test hole was discussed, and the team coordinator made a decision to continue with the work because there were no indications of additional buried obstructions in facility drawings or from ground scanning. The following day excavation activities resumed, and the back-hoe operator severed an abandoned electrical cable. Facility personnel held another critique and determined that digging test holes along the length of the telephone cable could have prevented the operator from severing it. No personal injury or property damage resulted from this event. Corrective actions include requiring test holes before excavation activities.

OEAF engineers reviewed the Occurrence Reporting and Processing System (ORPS) database and found 162 reports associated with near-miss occurrences involving cutting, damaging, or severing electrical cables. Figure 4-1 shows that facility managers reported management problems as the root cause for 46 percent of the events. Further review shows that 33 percent of the management problems were reported as work organization/planning deficiency problems. This indicates that management attention can prevent these type of events and the potential injuries associated with them.

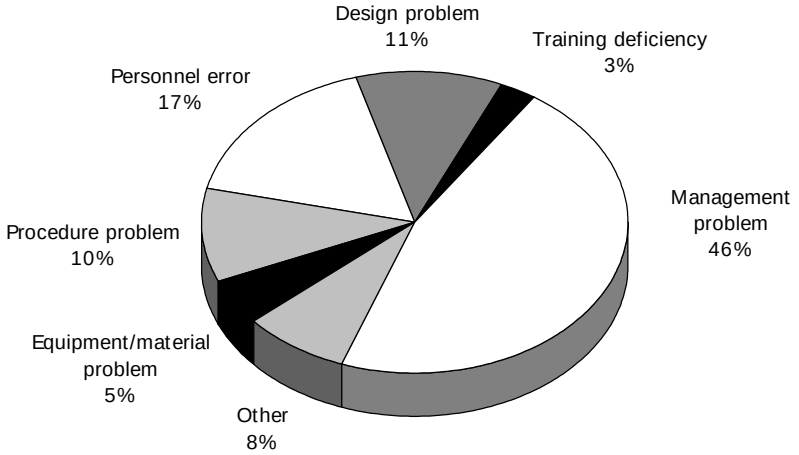

Figure 4-1. Distribution of Root Causes for Near-Miss Occurrences Involving Damaged Electrical Cables[1]

NFS reported events where workers severed or contacted electrical conduits or cables while drilling or excavating in Weekly Summaries 97-14, 97-11, 96-37, 96-42, 96-31, 96-17, 96-08, 96-05, 96-04, and 95-39.

- Weekly Summary 97-14 reported that decontamination and decommissioning workers at the Hanford N-Reactor cut through a conduit into an energized 220-volt cable. Investigators determined that the workers bypassed hold points required by the procedure. They also determined the assigned electrician did not conduct a zero energy check. (ORPS Report RL--BHI-NREACTOR-1997-0006)

- Weekly Summary 97-11 reported that a subcontract worker at Brookhaven National Laboratory struck an energized 120-volt electrical cable while drilling into a concrete floor. The worker saw sparks and immediately stopped work. (ORPS Report CH-BH-BNL-PE-1997-0003)

- Weekly Summary 96-04 reported that on January 17, 1996, at Los Alamos National Laboratory, a laborer was burned and rendered unconscious when he hit a 13.2-kV electrical power cable while excavating in a building basement. (ORPS Report ALO-LA-LANL-TSF-1996-0001 and Type A Accident Investigation Board Report on the January 17, 1996, Electrical Accident with Injury in Building 209, Technical Area 21, Los Alamos National Laboratory)

These events underscore the importance of using effective work control practices and detailed job planning to provide multiple levels of protection. In the Hanford floor-slab event, an expert obtained to determine if buried cables were present identified a suspect area. However, a communication failure between contracting organizations resulted in the 110-volt line being severed. In the Lawrence Livermore event, drawings were reviewed, scans were performed, and the line was located before work started. However, the line was not at the depth indicated on the drawings. In the Hanford abandoned lines event, there were multiple reviews of drawings, site conditions, and scans that resulted in locating part of one line before work started. However, a second line was not detected, and the first line did not run straight as expected. No injuries occurred because both lines were de-energized, but similar events with energized lines have occurred throughout the DOE complex. Safety and health hazard analysis must be included in the work control process to help prevent worker injury. The OSHA safety requirements of 29 CFR 1926, *Safety and Health Regulations for Construction,* sub-parts .651(b) and .416(a)(3) assign employers responsibility for identifying underground hazards and energized circuits near the work. The requirements of 29 CFR 1926.956(c) state that work must be conducted in a manner to avoid damage to underground facilities. Similarly, work must be performed in a manner that provides protection to the workers. DOE facility managers should review contractor safety guidelines to ensure compliance with OSHA standards.

1 OEAF engineers reviewed the ORPS database for nature of occurrence “10B” (near-miss) and narrative for “elect@ AND (conduit@ OR cable@) AND (cut@ or sever@ or damag@)” and found 162 occurrence reports DOE-wide from 1992 to August 11, 1997.

DOE/ID-10600, *Electrical Safety Guidelines*, prescribes DOE safety standards for the use of electrical energy at DOE field offices or facilities. Section 2.13.1.3 states that when circuits and equipment are worked on they must be disconnected from all electrical energy sources. Section 2.13.2 requires verification that all live circuits are disconnected, released, or restrained. Section 2.13.2.1 requires a qualified worker, using test equipment, to check the circuit elements and electrical parts and verify that they are de-energized. These guidelines are intended to protect personnel from electrical shock and potential fatalities.

DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, provides guidance on lockout/tagout program implementation and management at DOE facilities. Lockout/tagout programs in DOE serve two functions. The first function, defined in both 29 CFR 1910, *Occupational Safety and Health Standards*, and DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities,* is to protect personnel from injury and protect equipment from damage. The second function is to provide overall control of equipment and system status. Lockout/tagouts are typically applied during maintenance activities; however, there are many cases when lockout/tagouts are needed for personnel safety. The standard states that an effective lockout/tagout program requires three elements. These elements are as follows: (1) all affected personnel must understand the program; (2) it must be applied uniformly in every job; and (3) it must be respected by every worker and supervisor. A good lockout/tagout program is an important element of an effective conduct of operations program. DOE O 5480.19 states that DOE policy is to operate DOE facilities in a manner to ensure an acceptable level of safety and that procedures are in place to control conduct of operations. Chapter VIII, “Control of Equipment and System Status,” provides an overall perspective on control of equipment and system status. Specific applications of system control are addressed in chapter IX, “Lockout/Tagout,” and chapter X, “Independent Verification.”

NFS issued DOE/EH-0541, Safety Notice 96-06, ”Underground Utilities Detection and Excavation,” in December 1996. The notice provides descriptions of recent events, an overview of current technology for underground utility detection, specific recommendations for improving site utilities detection and excavation programs, and information on innovative practices used at DOE facilities. A central coordinator should not only assist in identifying underground utilities, but should also record those findings and maintain records for future excavation activities. Safety Notice 96-06 can be obtained by contacting the Info Center, (301) 903-0449, or by writing to ES&H Information Center, U.S. Department of Energy, EH-74, Suite 100, Century XXI/3, Germantown, MD 20874.

KEYWORDS: construction, electrical, renovations

FUNCTIONAL AREAS: Industrial Safety, Hazards Analysis, Work Planning